GEOLOGIC CHARACTERIZATION OF BLUE POND

CLAY COUNTY, FLORIDA

By

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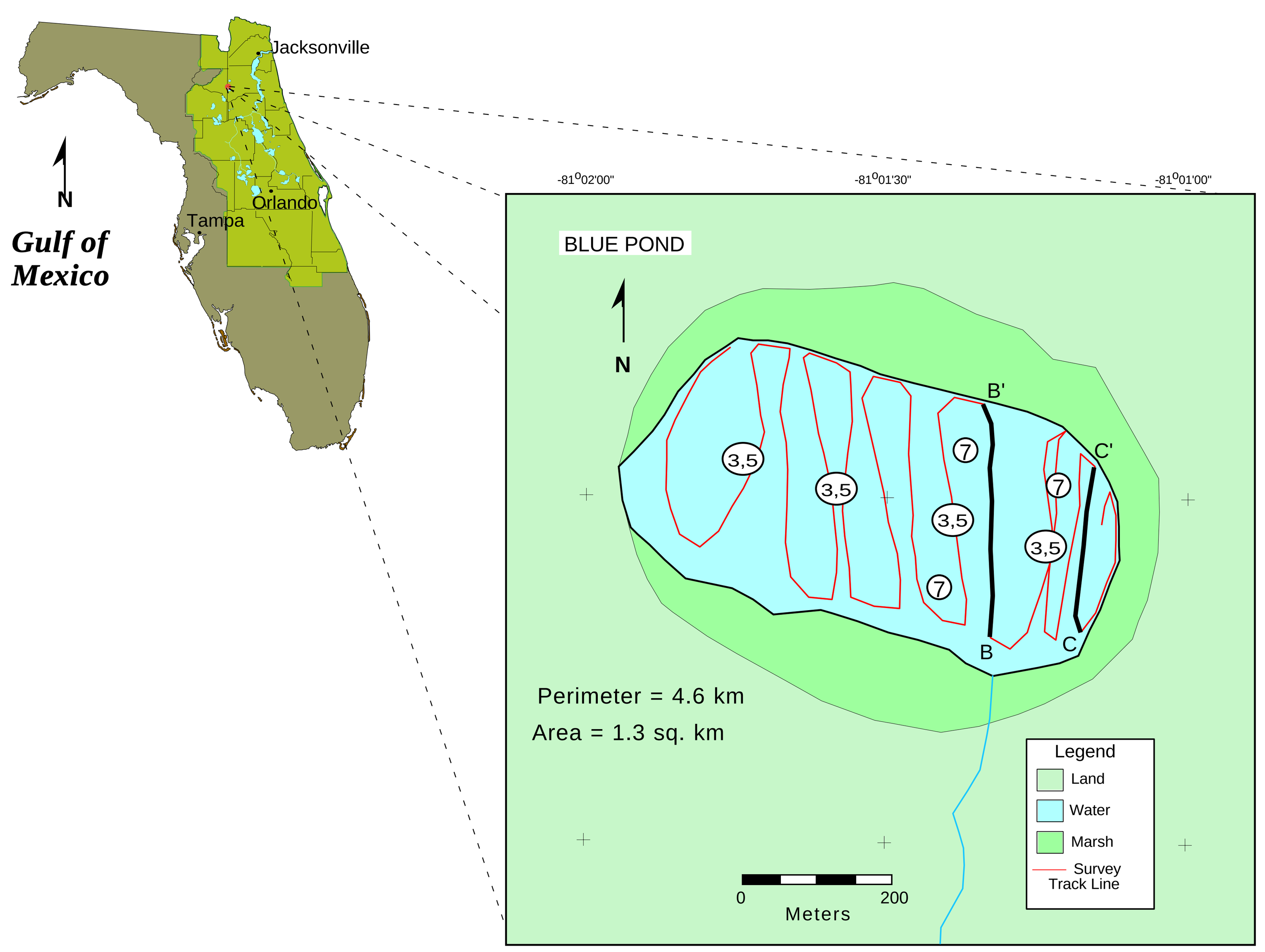
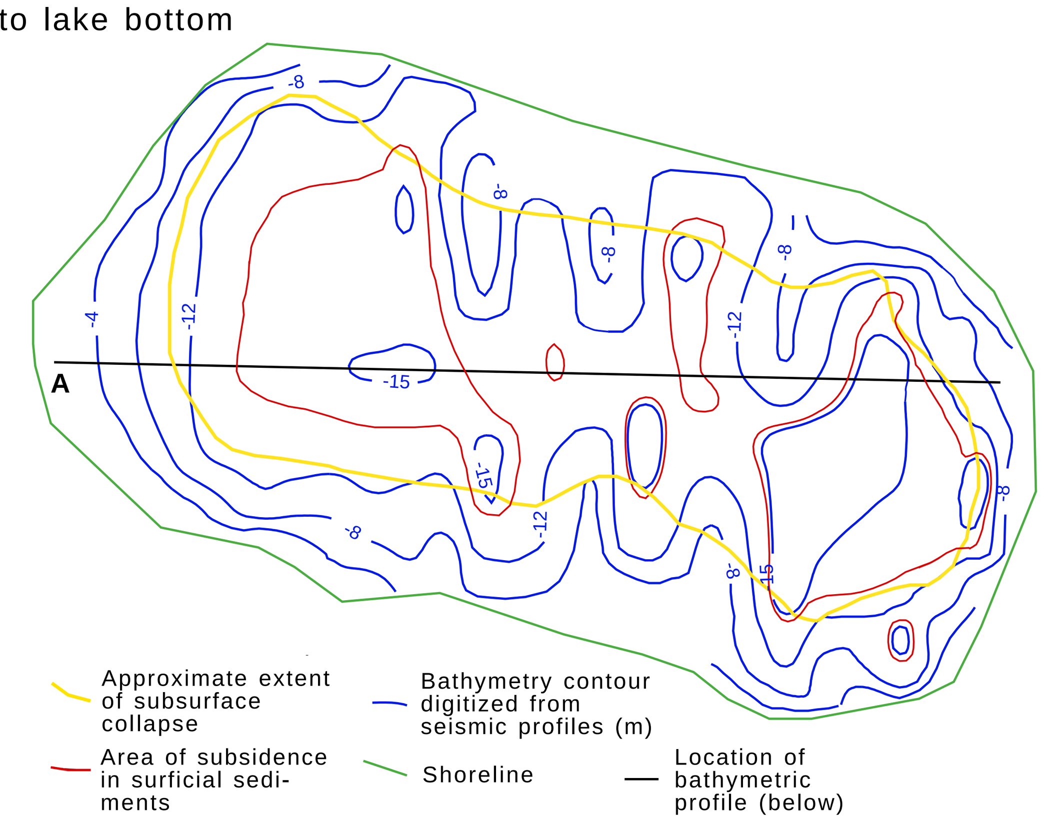
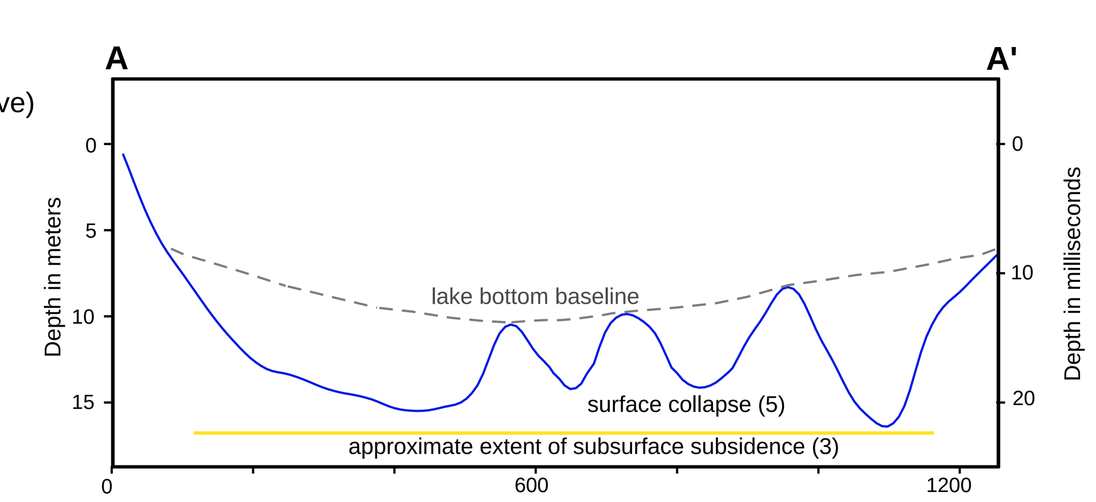


Depth to lake bottom



Bathymetric Profile

(profile location shown above)



INTRODUCTION

The potential fliud exchange between lakes of northern Florida and the Floridan aquifer and the process by which exchange occurs is of critical concern to the St. Johns River Water Management District (SJRWMD). High-resolution seismic tools with relatively new digital technology were utilized in collecting geophysical data from > 40 lakes and rivers. The data collected shows the application of these techniques in understanding the formation of individual lakes and rivers, thus aiding in the management of these natural resources by identifying breaches or areas where the confining units are thin or absent between the water bodies, the Intermediate aquifer and the Floridian aquifer.

This study was a cooperative investigation conducted from 1993 to 1996 by the SJRWMD and U.S. Geological Survey Center for Coastal Geology (USGS). Since 1989 there have been technical and hardware advances in the digital acquisition of high-resolution seismic data. The primary objective of this cooperative was to test newly developed digital high-resolution single-channel marine seismic continuous-profiling-equipment (HRSP) and apply this technology to identify subbottom features that may enhance leakage from selected lakes and the St. Johns River. The target features include: (1) identifying evidence of breaches or discontinuities in the confining units between the water bodies and the aquifer, and; (2) identifying areas where the confining unit is thin or absent.

METHODS

In cooperation with SJRWMD the USGS acquired and upgraded a digital seismic acquisition system. The Elics Delph2 High-Resolution Seismic System was acquired with proprietary hardware and software running in real time on an Industrial Computer Corp. 486/33 PC. Hard-copy data was displayed on a gray scale thermal plotter. Digital data was stored on a rewritable Magneto-Optical compact disk. Navigation data was collected using a Trimble GPS or PLGR (Rockwell) GPS. GeoLink XDS mapping software was used to display navigation.

The acoustic source was the Huntec Model 4425 Seismic Source Module and a catamaran sled with an electromechanical device. Occasionally, an ORE Geopulse power supply was substituted for the Huntec Model 4425. Power was set at 60 joules or 135 joules depending upon conditions. An Innovative Transducers Inc. ST-5 multi-element hydrophone was used to detect the return acoustical pulse. This pulse was fed directly into the Elics Delph2 system for storage and processing.

Forty-four line-km of HRSP data was collected from Lake Disston. A velocity of 1500 meters per second (m/s) was used to calculate a depth scale for the seismic profiles. Measured site specific velocity data is not available for these sites.

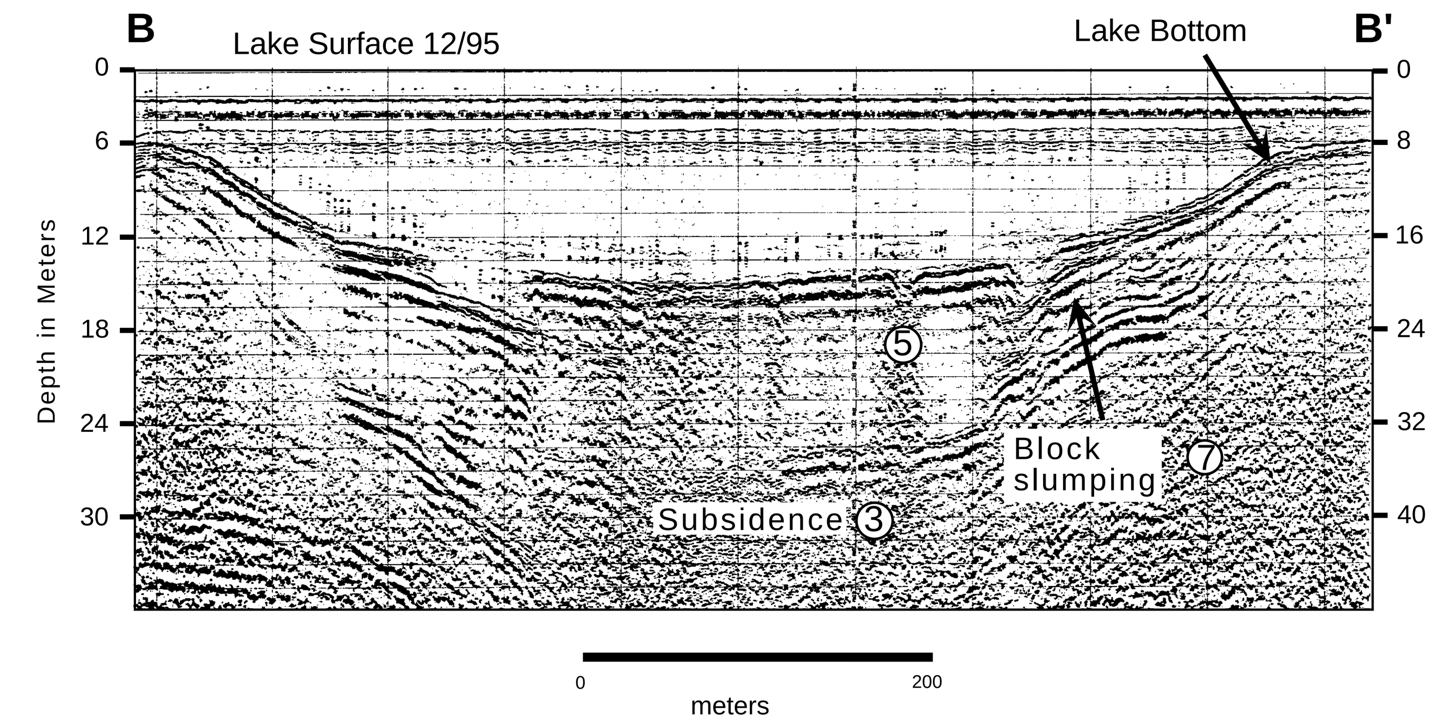
These surveys were conducted in part to test the effectiveness of shallow-water marine geophysical techniques in the freshwater lakes of central Florida. Acquisition techniques were similar but modifications were necessary. Data quality varied from good to poor with different areas and varying conditions. As acquisition techniques improved so did data quality in general. In many areas an acoustic multiple masked much of the shallow geologic data.

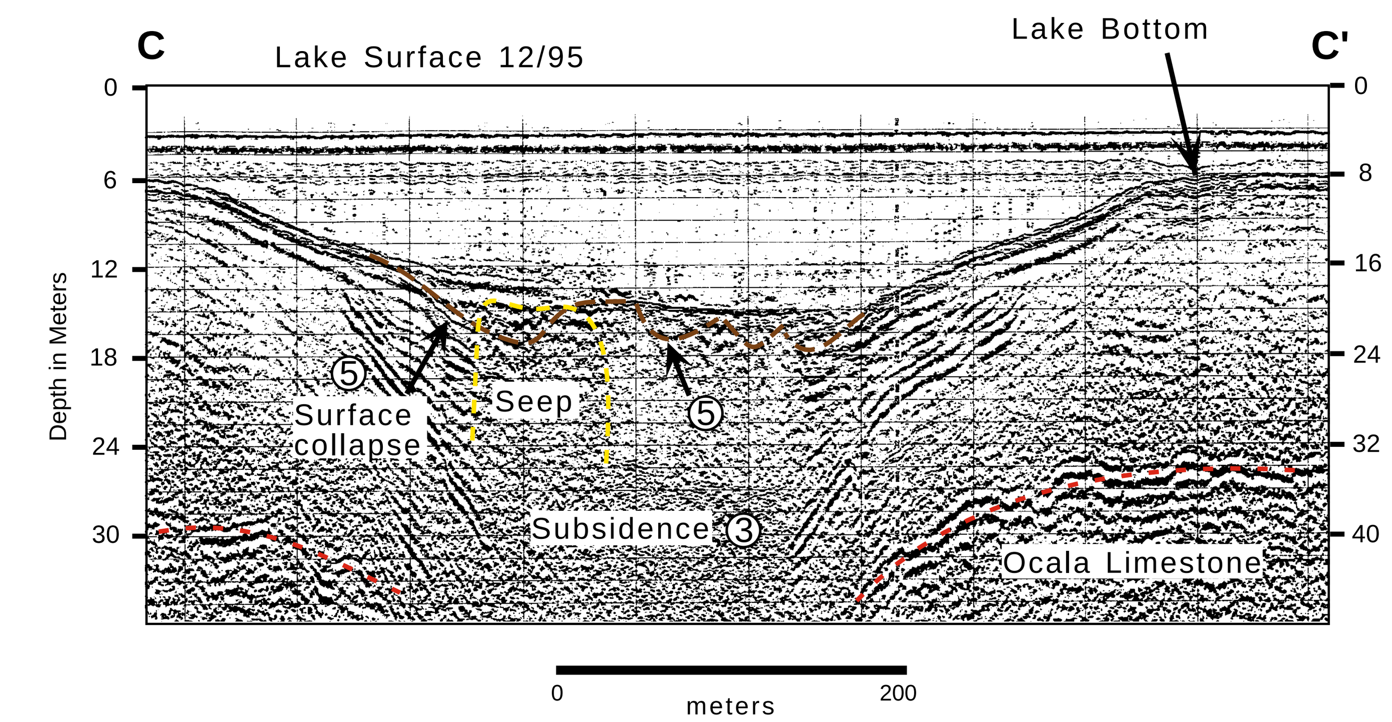
Physiography

Blue Pond is located in western Clay County. The lake borders on the Volusia Ridge Sets of the Eastern Flatwood District and the Interlachen Sand Hills of the Central Lakes District. Lake level at the time of the seismic survey was about 40 m (130 ft) NVGD. Blue Pond is oval shaped, approximately 750 x 350 meters with a perimeter of 4.6 km and the surface area of 1.3 sq km. Average water depth during the survey is about 30 feet. Blue Pond is connected surficially to Sand Hill Lake to the south.

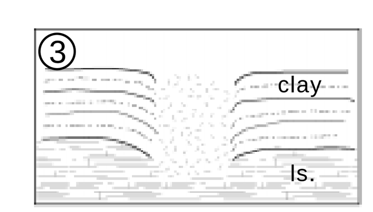
GEOLOGIC CHARACTERIZATION

Blue Pond appears to be comprised of a single large depression, as evidenced in the seismic profile examples B-B' and C-C'. The other lakes surveyed in this area all appear to have this characteristic (i.e. single basin, single sink), as opposed to lakes elsewhere that contain multiple depressions. A strong subsurface reflective horizon at about 30m below lake level (C-C'), or -18 m NVGD, is interpreted to be the top of the Ocala Formation. This surface is collapsed throughout most of the lake as shown in yellow in the bathymetry map to the left. The subsurface collapse has created general surface subsidence, as well as slumping of overburden into the depression (B-B'). Smaller areas of surface collapse are evident in the surface sediments (brown line, C-C'). This feature is seen elsewhere in the study area and has been classified as a Type 5 karst feature, as shown in the explanation below. The smaller collapse structures may be a result of accomodation during subsidence, or solution pipes created by dissolution from freshwater flowing through the depression. An acoustic signal characteristic of a freshwater plume is shown at one of these features (C-C'). The areas of surface collapse have been mapped out (red) in the contour plot to the left. The profile below the contour plot (A-A') shows the relationship between the lake bottom, the surface features and the subsurface collapse. The geometry of the subsidence has apparently created a lot of acoustic noise, which masks returns from any structure in the depression. This acoustic signature is relatively common (Type 3) and can be compared with similar seismic returns seen in other lakes in the study area.

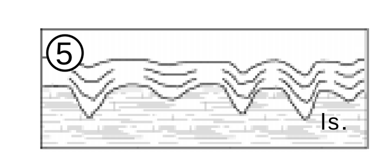




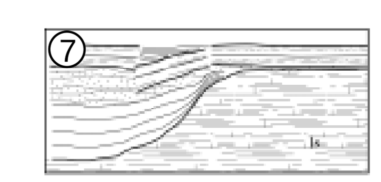
EXPLANATION



Horizontal reflectors continuous on either side of a central non-reflective zone. Horizontal layers bend downward towards the central zone. These features are representative of filled collapse sinks. The size may range from tens of meters to kilometers across a lake basin.



Numerous small features with high angle reflectors dipping toward their center. These features may represent localized collapse sinks or filled solution pipes.



Mid- to high-angle parallel reflectors with indications of vertical displacement and rotation. Feature may be buried by overburden. Represents blocks from the sides of collapse sinks that have slumped into the sink.